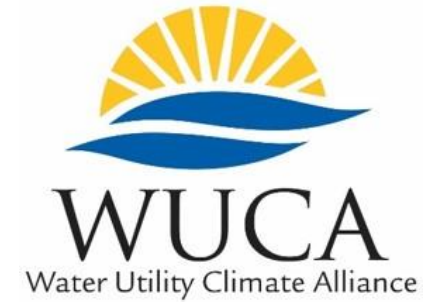


**Building Resilience to a Changing Climate:  
A Technical Training in Water Sector  
Utility Decision Support**



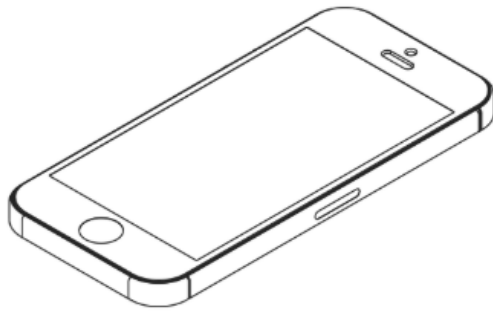
# **Practical Considerations for Climate Analysis and Adaptation: Know before you go ...**

**Laurina Kaatz, Denver Water / WUCA**

# Group Polling

1. How are you feeling about scientific uncertainty in the context of climate adaptation decision making?
2. How confident are you in your ability to effectively use climate science in long-range planning?

Go to [www.menti.com](https://www.menti.com) and use the code **90 34 91**



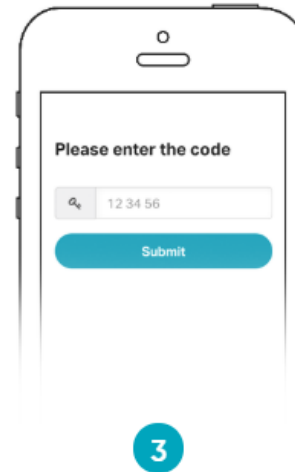
1

Grab your phone

[www.menti.com](https://www.menti.com)

2

Go to [www.menti.com](https://www.menti.com)



3

Enter the code 90 34 91 and vote!

# Climate Adaptation Conundrum

- Can't be prepared for everything
- Can't afford to be prepared for the worst case
- Can't afford to be unprepared

*How do you approach this challenge?*

# Four Adaptation Steps

- **Understand:** Climate science and model projection capabilities and limitations
- **Assess:** Water system vulnerability to potential change
- **Plan:** Incorporate climate uncertainty into water utility planning
- **Implement:** Adaptation strategies

# Before You Jump In – Clearly Articulate...

- What is your end game? What question(s) do you want to answer?
- How will you get there?
  - Method – simple, sophisticated
  - Data – type, scale
  - Tools – current, new?
  - Will it be useful?
- New science?
- Messaging – internal, external



Source: L. Kaatz, Denver Water

# Goal is to Avoid Analysis Paralysis



# Do Understand How the Decision Being Evaluated is Important to Model and Approach Selection

What are the questions we are trying to answer?

How will flows in April-September change in the future?

How should facilities be sized to prevent sewer overflows?

How will the magnitude, duration, and frequency of drought change?

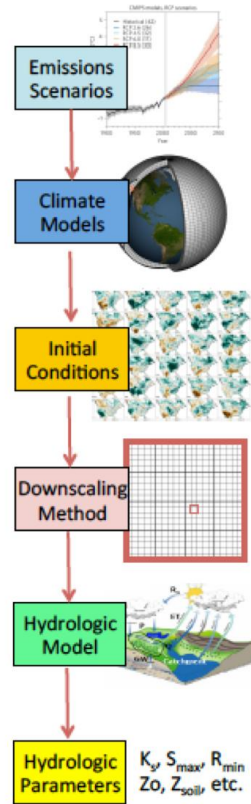
How much warmer will streams be in 20 years?

water supply, streamflow timing, drought, stormwater, wastewater

## **FIT FOR PURPOSE**

# Do Be Aware of Multiple Ways to Evaluate Future Changes

## Scenario studies



Clark et al. 2016; connect models in a chain

## Stochastic hydrology

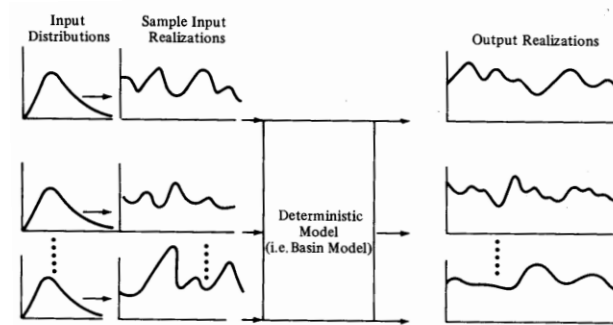
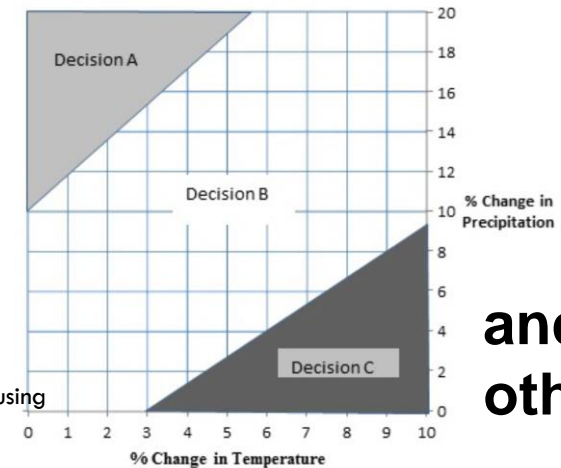


Figure 1.3 Concept of Monte Carlo experiments.

Bras and Rodriguez-Iturbe, 1985; generate synthetic timeseries using statistics from the past

## Climate-informed vulnerability analysis

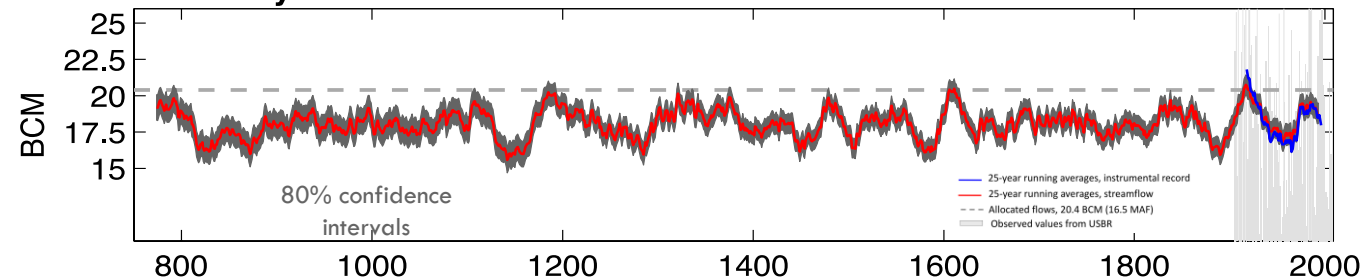


and others...

## Paleoclimate studies

Brown et al., WRR, 2016; explore system vulnerabilities with perturbations

### 1250-year Streamflow Reconstruction



Vano et al., BAMS, 2016; generate timeseries using reconstructions of the distant past

# Do Start by Determining the Level of Details that Fits Your Need and Resources

## **Additional Considerations:**

- How much will it cost?
- How long will it take?
- To what extent will the analysis improve the decision?
- Can appropriate data and information be obtained?
- Who will undertake the analysis?
- How much information can you manage?



# Guiding Principles

- I. It is important to evaluate climate risk
- II. Models can be helpful tools, if used appropriately
- III. Uncertainty is everyone's responsibility

**Water managers**  
planning for the  
unexpected is their  
responsibility



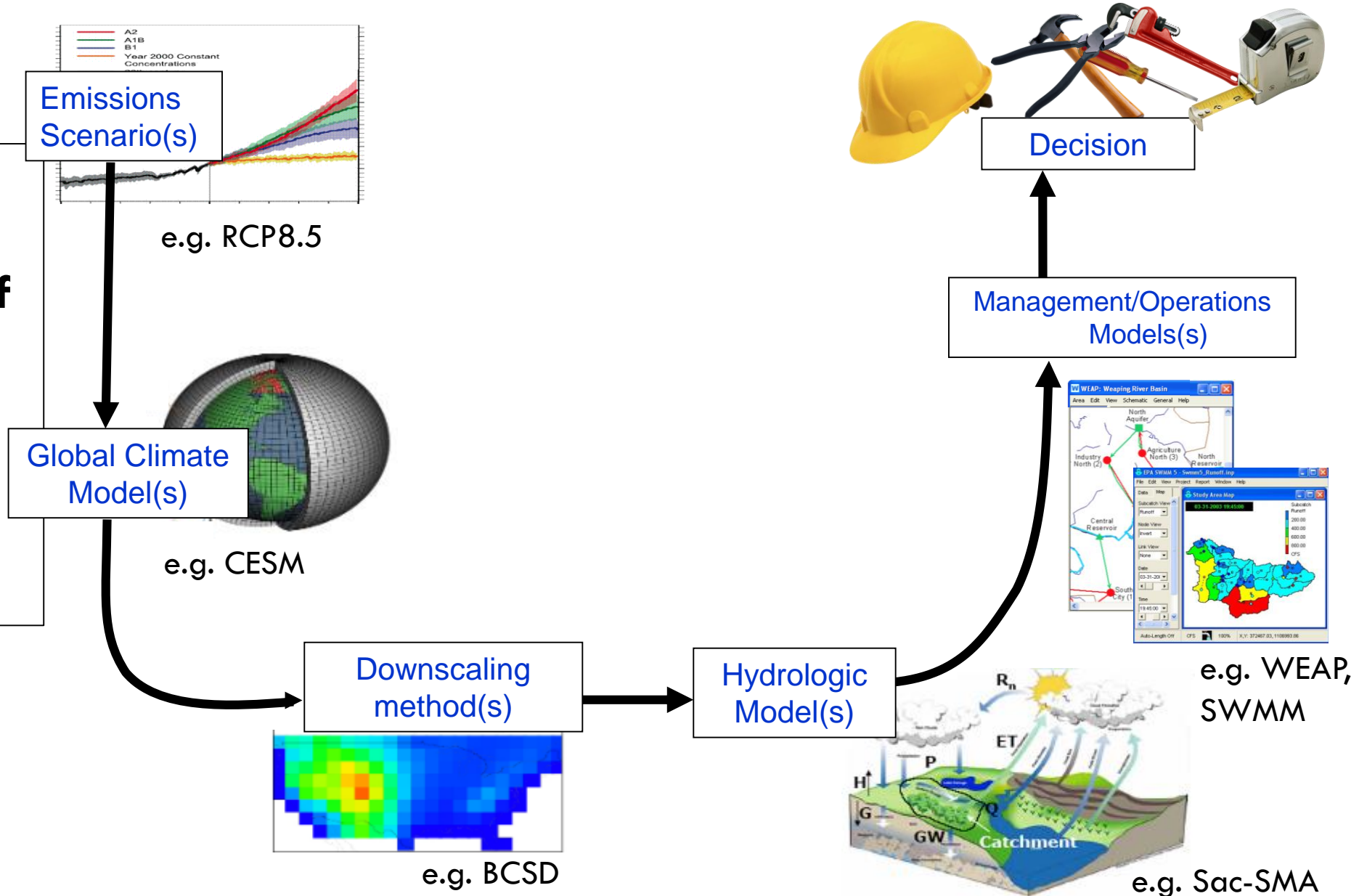
**Scientists** being clear  
about uncertainties and  
placing them in context is  
their responsibility

# Classic “Top-Down” Chain of Models

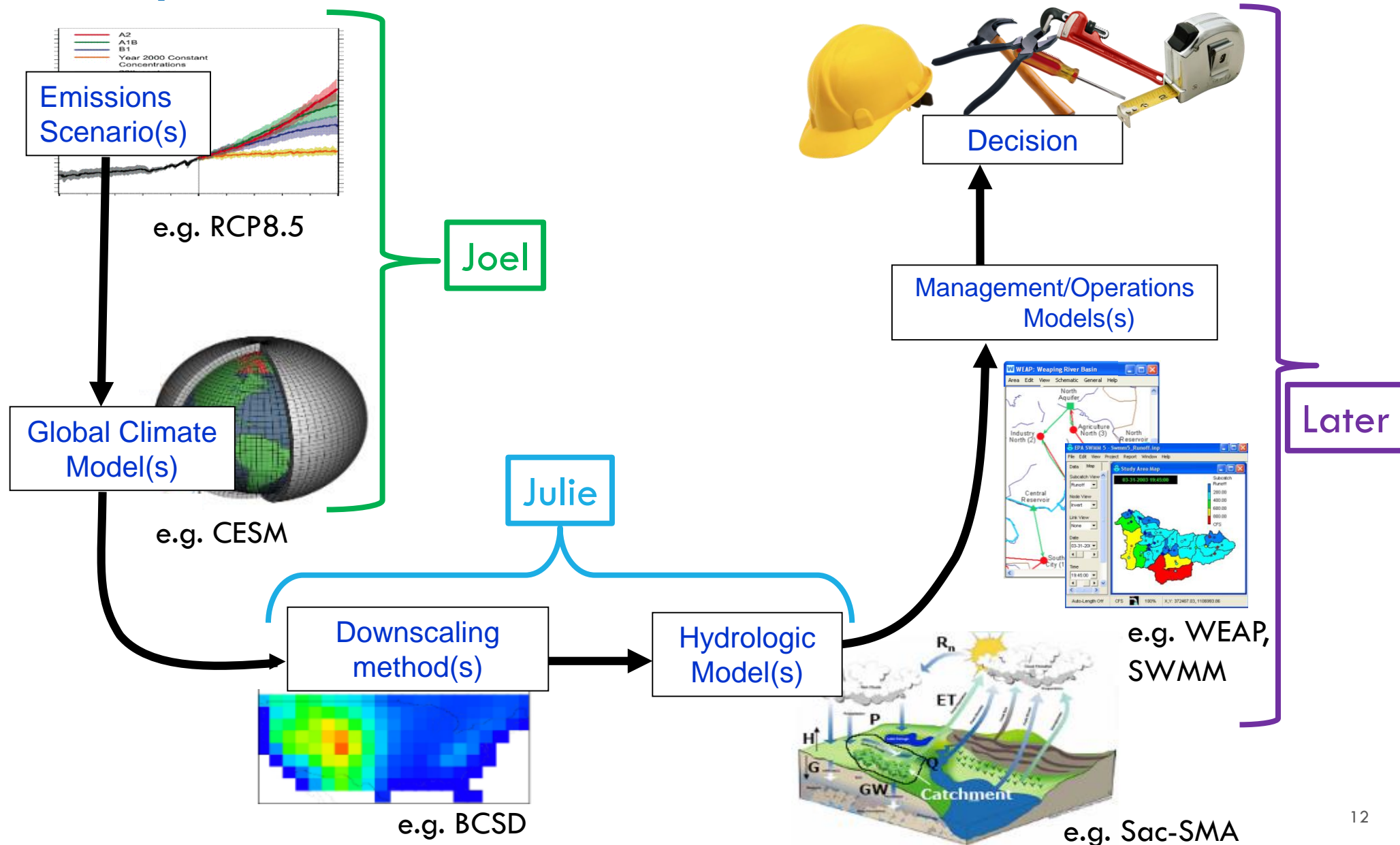
## Note:

This is not an endorsement of a top-down approach.

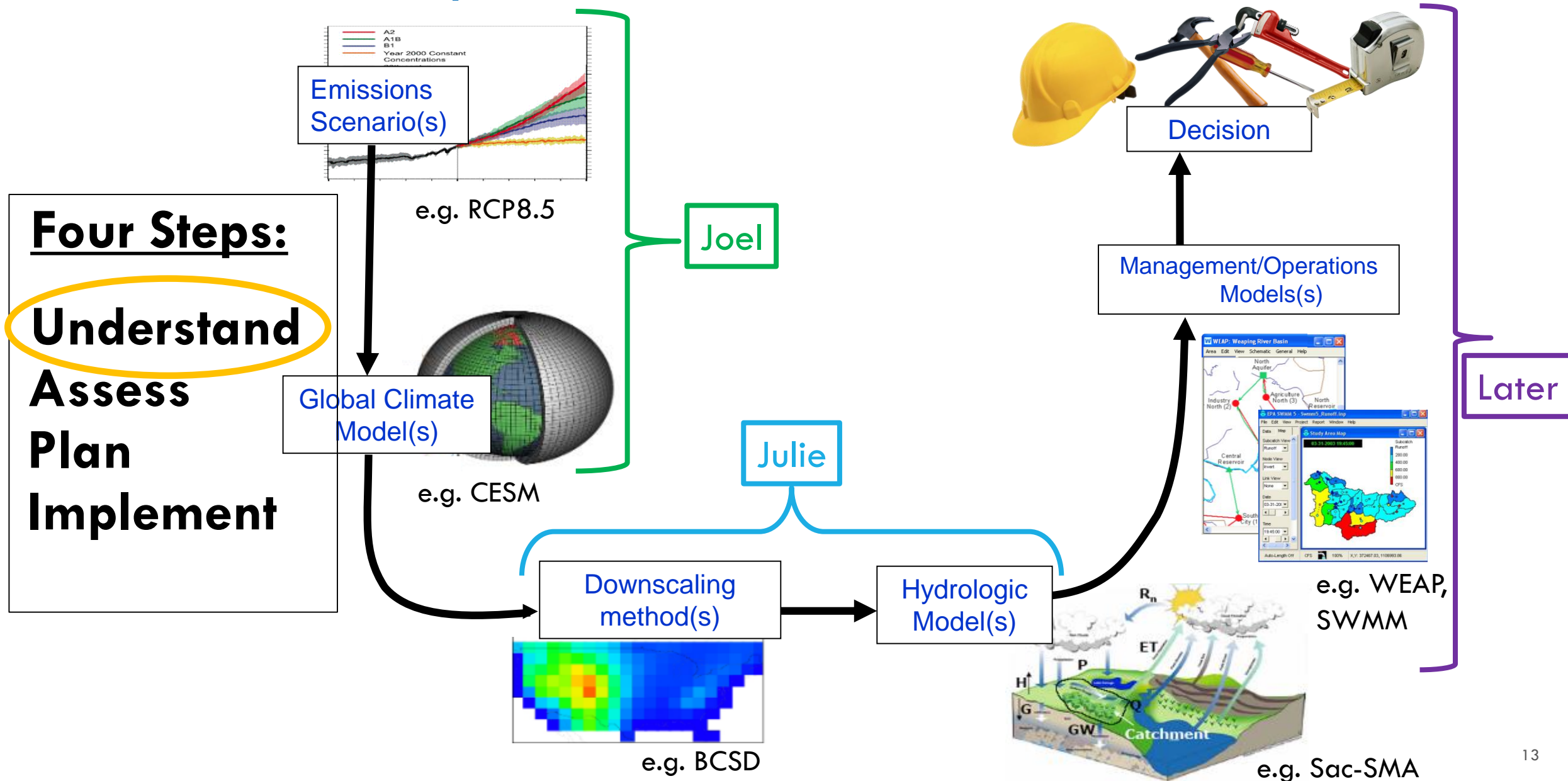
It is to orient participants to the upcoming training topics.



# Classic “Top-Down” Chain of Models



# Classic “Top-Down” Chain of Models



# Questions?